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THE VELIGER

Acochlidium fijiensis sp. nov. (Gastropoda: Opisthobranchia: Acochlidiacea) from Fiji

by

A. HAYNES AND W. KENCHINGTON

School of Pure and Applied Sciences, The University of the South Pacific,
P.O. Box 1168, Suva, Fiji

Abstract. A new species of freshwater opisthobranch, *Acochlidium **fijiensis***, collected from stones in the Nasekawa River, Vanua Levu, Fiji, is described and its gross anatomical features are discussed and compared with those of other species of *Acochlidium*. Individual *Acochlidium **fijiensis*** reached maturity from July to October when the population was most abundant. Eggs were laid in a jelly mass attached to stones and the young hatched as veligers.

INTRODUCTION

The Acochlidiacea is the only opisthobranch order in which freshwater species are found and all of these have been discovered on islands. The freshwater species are *Strubellia paradoxa* (Strubell, 1892) from Guadalcanal, Solomon Islands, and Amboina, Indonesia (WAWRA, 1974), *Acochlidium amboinense* Strubell, 1892, from Amboina, *Acochlidium weberi* Bergh, 1896, from Flores (placed in the new genus, *Palliohedyle* by RANKIN [1979] but classification disputed by Wawra [personal communication]), *Acochlidium suteri* Wawra, 1979, from Sumba, Indonesia, *Acochlidium bayerfehlmanni* Wawra, 1980, from Palau (WAWRA, 1980), and *Tantulum elegans* Rankin, 1979, from St. Vincent in the Caribbean (RANKIN, 1979).

MATERIALS AND METHODS

*Acochlidium **fijiensis*** was first collected 7 km upstream from the mouth of the Nasekawa River at the bridge on the Labasa-Savusavu highway on the island of Vanua Levu, the second largest island in Fiji (site, 16°40′S, 179°16′E) in October 1983 (HAYNES, 1988). Subsequently other Fijian streams and rivers have been searched for this species. The only other place where it has been found is 4 km upstream from the mouth of the Lami River, Viti Levu, the main island of Fiji (site, 18°06′S, 178°24′E). Bernadette Holthuis found 5 specimens of *A. **fijiensis*** in the Lami River in November–December 1988. Small *A. **fijiensis*** populations may exist elsewhere in Vanua Levu and Viti Levu but, because individuals are well camouflaged and blend with the stones under which they live, they are difficult to detect.

Radulae were dissected from three preserved *Acochlidium **fijiensis***. They were cleared with 10% potassium hydroxide and mounted in glycerine. The penis glands were removed from each dissected specimen, mounted in glycerine, and examined under a stereoscopic microscope.

For histology, specimens were killed and fixed in Bouin's fluid. Best results were obtained when the animals were first relaxed by lowering their temperature to about 4°C in the refrigerator. Extended, torpid specimens were immersed in ice-cold Bouin's fluid for 1 hr followed by 24 hr at room temperature. Fixed specimens were washed in running tap water for 12 hr, dehydrated in a graded series of ethanol dilutions (10–100%), cleared in xylene, and embedded in paraffin wax (melting point 60°C) under vacuum. Sections were cut at 7 μm and stained with Erlich's haematoxylin and eosin.

Water samples were analyzed by the Institute of Natural Resources, University of the South Pacific. In general, methods for chemical analysis of water samples were those described in *Standard Methods for the Examination of Water and Wastewater* (AMERICAN PUBLIC HEALTH ASSOCIATION, 1981).

TAXONOMY

*Acochlidium **fijiensis*** Haynes & Kenchington, sp. nov.

(Figures 1–6)

Type locality: Nasekawa River, Vanua Levu, Fiji. Collection site at 16°40′S, 179°16′E.

Type specimens: The holotype (LACM 2457) and 2 paratypes (LACM 2458) have been deposited in the Los

Figure 1

Photograph of a live *Acochlidium* ***fijiensis***. The irregular pattern of white patches over the hump and foot is caused by spicules.

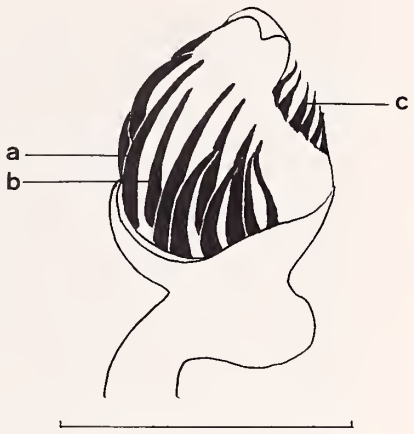

Figure 3

Penis gland of *Acochlidium* ***fijiensis*** showing: a, outer row of hooks; b, inner row of hooks; c, 6 small spines on the edge of the vas deferens opening.

Angeles County Museum of Natural History. Ten paratype specimens of *Acochlidium* ***fijiensis*** have been deposited in the Naturhistorisches Museum Wien, Inventory Number 84.901, and 7 paratypes, a radula, a penis permanently mounted in glycerine and slides of sectioned gonads are held in the Biology Department, School of Pure and Applied Sciences, University of the South Pacific, Suva. The dissected specimens were collected in January 1988; holotype, paratypes, and sectioned specimens were collected in July 1989. All type specimens were collected by A. Haynes.

Size, abundance and maturity: Table 1 indicates the relative abundance and size of specimens of *Acochlidium*

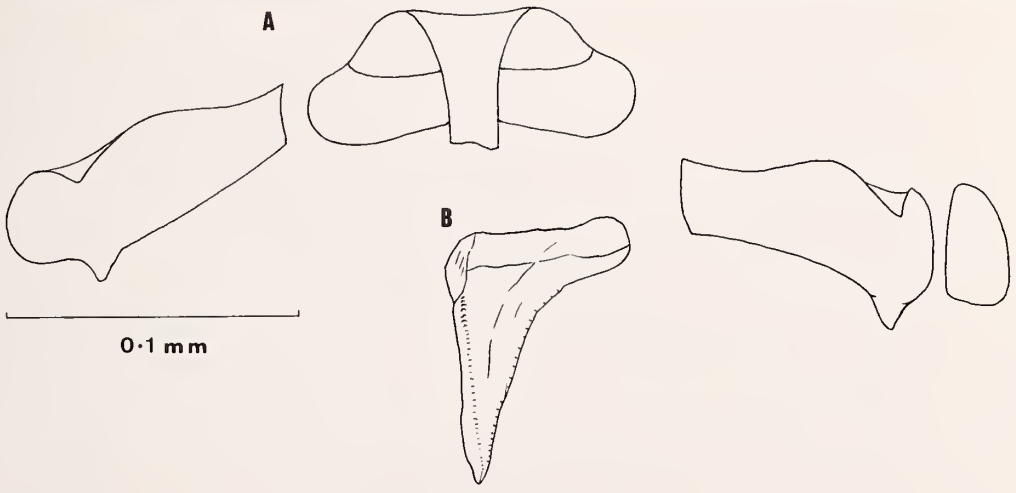

Fig. 2

Figure 2A. Ventral view of a row of radula teeth of *Acochlidium* ***fijiensis***. B. Side view of median tooth showing fine serrations.

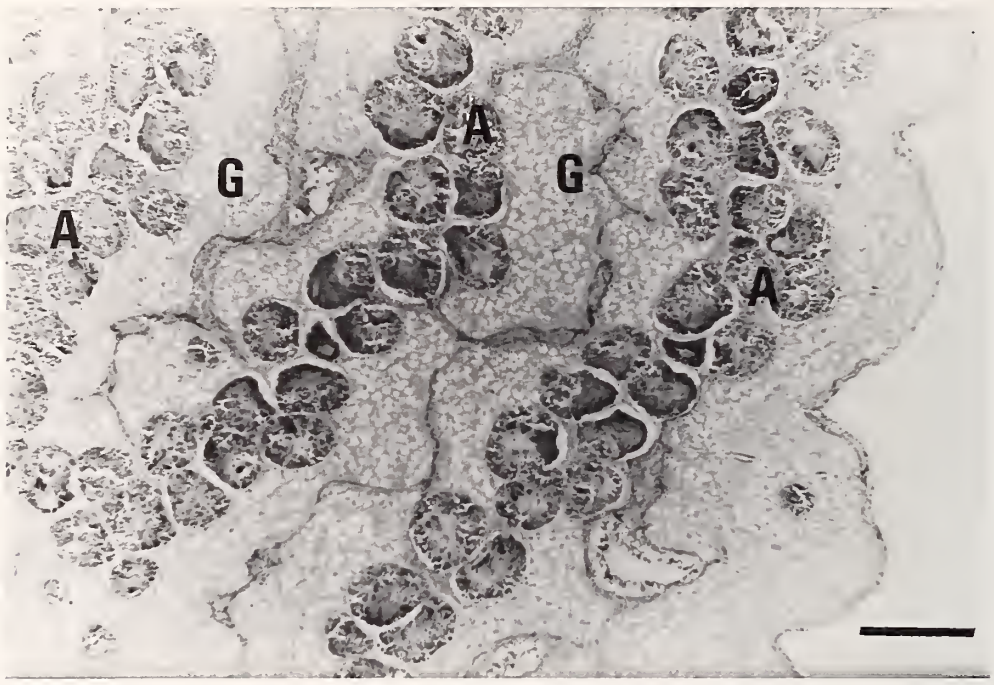

Figure 4

Coronal (horizontal longitudinal) section of the visceral hump of *Acochlidium* ***fijiensis*** stained with haematoxylin and eosin showing the extensive distribution of ovotestis acini (A) embedded in diverticula of the digestive gland (G). Scale bar = 0.1 mm.

fijiensis collected from the Nasekawa River on five occasions from October 1983 to July 1989. *Acochlidium* ***fijiensis*** was most abundant in October 1983 and July 1989, and individuals were also largest in July 1989 when their body hump was enlarged because they were reproductively mature. Histological sections of *A.* ***fijiensis*** specimens collected from the Nasekawa River in January 1988 and from the Lami River in November–December 1988 showed undeveloped gonadal tissue. Sections of specimens collected in July 1989 contained mature gonads (Figures 4, 5). This suggests that *A.* ***fijiensis*** has a well-defined breeding season (July–August, or perhaps longer during the cool, dry season) and that, after breeding, either the gonads disintegrate or each individual breeds only once in its lifetime. In the mature individuals that had been prepared for histology, abundant yolk granules and sperm were noted, but very few oocytes could be seen. Presumably these specimens had already spawned.

Habitat: Specimens of *Acochlidium* ***fijiensis*** were found on the underside of stones and rocks in shallow water, 60–140 mm deep, near the water's edge in both the Nasekawa and Lami rivers. When *A.* ***fijiensis*** were kept in the laboratory, they always moved to the underside of the stones.

At the site in the Nasekawa River, the water level rose as much as 400 mm at high tide when heavy rain had been falling. However, when this occurred, there was little difference in the conductivity (or total ions) of the water at high and low tides (Table 2); therefore, the rise in water level is due to a back up of river water and not to inflowing seawater.

The chemical content of the water was similar at each sampling time and at high and low tides (Table 2). The water temperature was 29°C in October 1983 when *Acochlidium* ***fijiensis*** was abundant but at other times when the site was visited the temperature was 25–26°C (Table 2).

General Description

Diagnosis: Length of animal up to 19 mm, foot longer than visceral hump, which is rounded at the posterior (except when eggs have been shed, when the posterior may be ragged and pointed). Color cream-yellow, with wide

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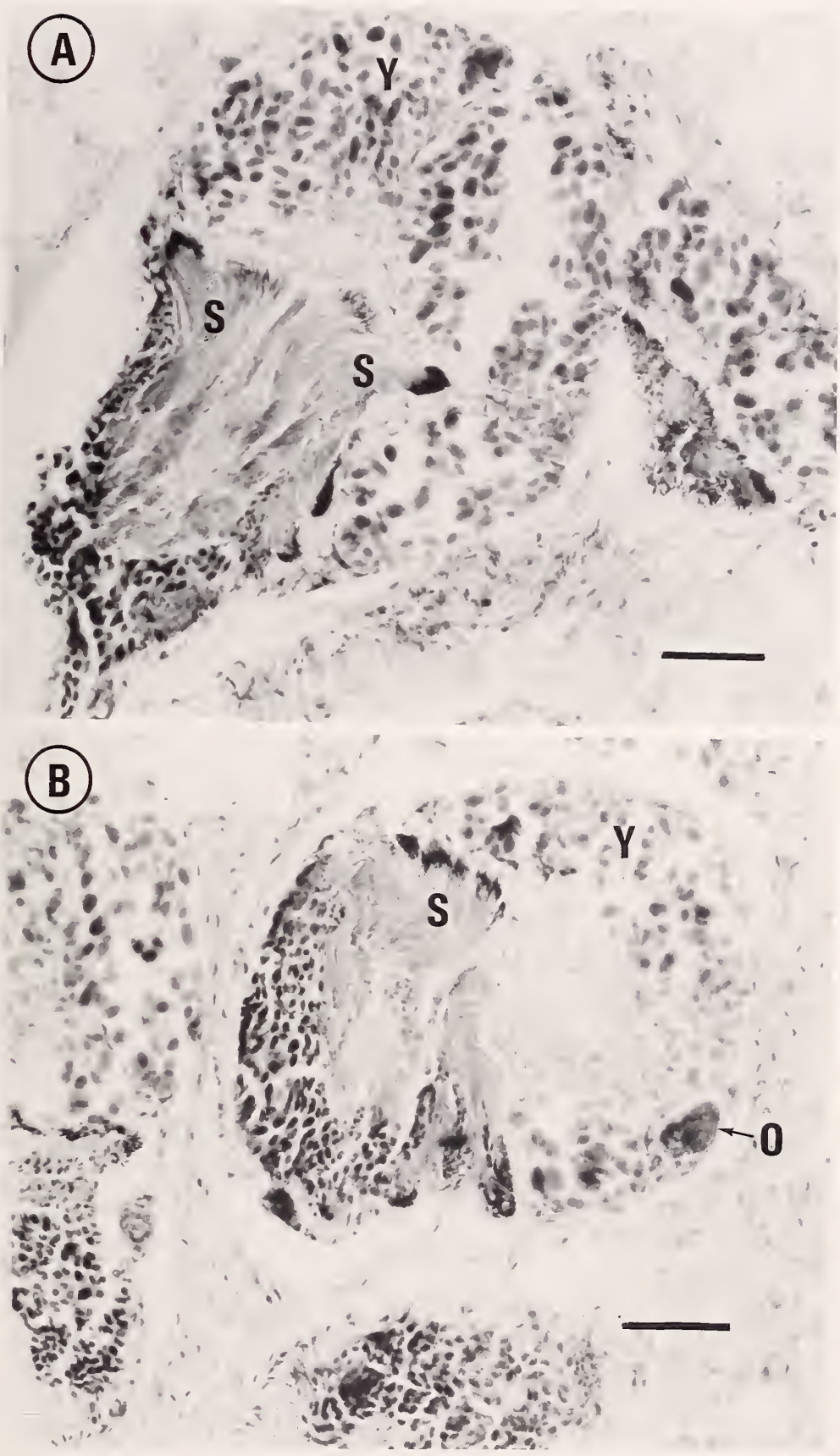
Figure 5

Histological sections through the ovotestis of *Acochlidium* ***fijiensis*** stained with haematoxylin and eosin. A. See abundant spermatozoa (S) and yolk granules (Y). B. See spermatozoa, yolk granules and a possible oocyte (O). Scale bar = 50 μm.


A
Y
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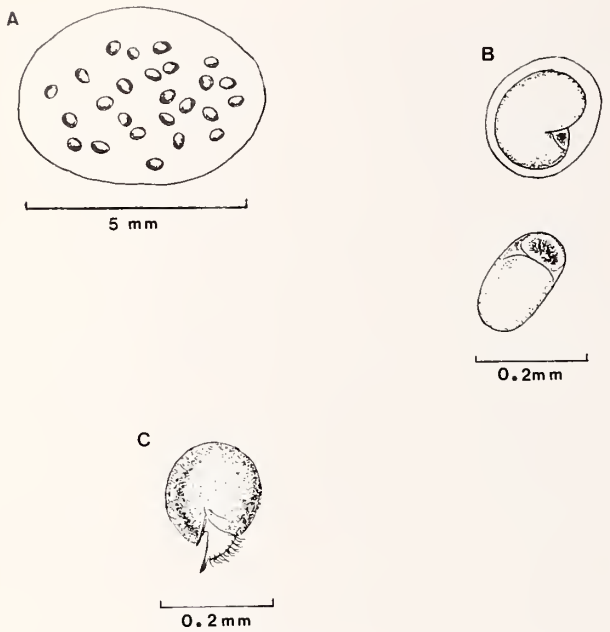

Figure 6

Acochlidium fijiensis. A. Developing eggs embedded in a jelly mass. B. Developing veligers, one still inside the egg membrane. C. Veliger larva swimming, after escaping from the egg membrane.

brown stripes across the dorsal side. Rhinophores (3.5 mm live; 1.8 mm preserved) longer than the anterior pair of tentacles (1.6 mm live; 0.8 mm preserved). Spicules present on visceral hump and foot (Figure 1).

Radula: Asymmetrical with formula 50 × (1·1·2·). Left marginal plate lacking and rachidian (median) tooth finely serrated (Figure 2A, B).

Hermaphrodite: The penial armature consisting of a double row of long, curved hooks that form a border that almost surrounds the penial gland. A line of 6 small spines borders one side of the vas deferens opening (Figure 3).

Reproduction and development: *Acochlidium* ***fijiensis*** is a hermaphrodite. This conclusion is based on an observed spawning followed by dissection revealing a well-developed penis. Also, sections of gonads (Figures 4, 5) show typical ovotestis composed of numerous acini, which are extensively distributed throughout the visceral hump where they are embedded amongst the diverticula of the digestive gland. In the specimens examined, acini were dominated by spermatozoa, spermatids, and associated generative tissue. Although yolk material was abundant, few oocytes were seen.

The spawning occurred in a 15-mm-long specimen that had been collected on 7 August 1984 and transferred to an aquarium. Thirteen days after capture it laid eggs, and three days later it died. The jelly mass was attached to two separate stones: one mass contained 31 eggs and the other 25 eggs (Figure 6A). The yellow eggs were embedded in clear jelly. After 10 days veligers were observed moving within the jelly (Figure 6B). After a further 12 days some of the veligers had escaped from the jelly mass and were swimming freely (Figure 6C). No veligers survived more than two days after leaving the jelly mass.

Table 1

The abundance and size of *Acochlidium* ***fijiensis*** collected from the Nasekawa River at different times.

Date	Number found	Duration of collection (hr)	Size (mm)
22 October 1983	16	1	not measured
7 August 1984	1	0.5	15
18–19 October 1985	12	6	6–11
19–20 January 1988	20	6	2–12
17 July 1989	30	2	10–19

Table 2

Physical and chemical parameters at the collecting site of *Acochlidium* ***fijiensis*** in the Nasekawa River.

	22 October 1985		22 January 1988	
	Low tide	High tide	Low tide	High tide
Temperature (°C)	26	25	25	25
Water depth (mm)	60–140	460–600	60–140	60–160
Water speed ($cm \cdot s^{-1}$)	0–30	0–10	0–30	0–30
pH	6.8	6.7	7.4	7.4
Conductivity ($\mu s \cdot cm^{-1}$)	97.9	100.7	102.6	102.6
Total nitrogen ($mg \cdot L^{-1}$)	8.2	7.1	2.5	2.5
Total phosphorus ($\mu g\ L^{-1}$)	62.0	74.0	21.3	21.3
Ca ($mg\ L^{-1}$)	7.8	8.2	9.2	9.2
Mg ($mg\ L^{-1}$)	5.5	5.6	4.1	4.1
Na ($mg\ L^{-1}$)	4.4	4.8	6.6	6.6
K ($mg\ L^{-1}$)	0.26	0.29	0.85	0.85

Discussion

A comparison of live *Acochlidium* ***fijiensis*** with other live *Acochlidium* species is not possible as no descriptions of the latter are available. Preserved specimens of *A.* ***fijiensis*** were similar in appearance to those described by Wawra for *A. sutteri* and *A. bayerfehlmanni*. The radula of *A.* ***fijiensis*** was asymmetrical, as were those of *A. sutteri* (Wawra, 1979) and *A. bayerfehlmanni* (Wawra, 1980). In the case of *A.* ***fijiensis***, the number of rows of teeth was 50 compared with 52–56 for other *Acochlidium* spp. except *A. weberi*, which had 93–103 (Wawra, 1979). The rachidian teeth appeared to be comparatively narrower (110 μm compared with 200 μm in *A. amboinense* and *A. sutteri* and 210–230 μm in *A. bayerfehlmanni*) and stouter, al-

though the laterals were approximately the same length (110–150 μm) (Wawra, 1979, 1980) (Figure 2).

The male genital system of *Acochlidium* ***fijiensis*** was also similar to that of *A. sutteri* and *A. bayerfehlmanni*, with the male opening at the base of the right rhinophore (Wawra, 1979, 1980). The armature on the penial gland appeared to be more similar to that of *A. bayerfehlmanni* than *A. sutteri*. However, the hooks in a double row nearly surrounding the penial gland in *A.* ***fijiensis*** were long and curved and the 6 small sharp spines were in a row on one side of the penis opening (Figure 3). In *A. bayerfehlmanni* the hooks are smaller and straighter and are not so extensive.

The general anatomy of *Acochlidium* ***fijiensis*** more closely resembled that of *A. bayerfehlmanni* than *A. sutteri* but the penial armature was distinctly different from both. Live *A.* ***fijiensis*** were smaller (19 mm long) than *A. bayerfehlmanni* (25 mm long) (Wawra, 1980). However, because such characteristics as the presence or absence of spicules and the comparative length of rhinophores and anterior tentacles have not previously been recorded, it is impossible to use them for comparisons within the genus *Acochlidium*.

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LITERATURE CITED

American Public Health Association. 1981. Standard Methods for the Examination of Water and Waste Water. 15th ed. American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington, D.C.

Haynes, A. 1988. The gastropods in the streams and rivers of five Fiji islands: Vanua Levu, Ovalau, Gau, Kadavu and Taveuni. The Veliger 30(4):377–383.

Rankin, J. 1979. A freshwater shell-less mollusc from the Caribbean: structure, biotics, and contribution to a new understanding of the Acochlidioidea. Life Sciences Contributions, Royal Ontario Museum 116:1–123.

Wawra, E. 1974. The rediscovery of *Strubellia paradox* (Strubell) (Gastropoda, Euthyneura, Acochlidiacea) on the Solomon Islands. The Veliger 17(1):8–10.

Wawra, E. 1979. *Acochlidium sutteri* nov. spec. (Gastropoda, Opisthobranchia, Acochlidiacea) von Sumba, Indonesien. Annalen des Naturhistorischen Museums in Wien 82:595–604.

Wawra, E. 1980. *Acochlidium bayerfehlmanni* spec. nov. (Gastropoda: Opisthobranchia: Acochlidiacea) from Palau Islands. The Veliger 22(3):215–218.